

membrane (fig. 34, *ee*), while the whole of the inner part of the skeleton was imbedded in sarcode charged with minute cells and granules (fig. 34, *bb*), among which could be perfectly distinguished the monociliated spongozoa, isolated (probably from the force used in tearing the specimen to pieces for examination), and in the aggregated globular forms of the ampullaceous sacs of the species (fig. 36, *c, d, g*), both of which corresponded in appearance and measurement with the like in the parent sponge, which had been previously examined, measured, and sketched for this reference, and may be found among the illustrations (Pl. XXI. fig. 23).

Thus the sponge-ovule, from its first appearance to its final development into the perfect sponge, had been completely traced; and thus its apparently chaotic mass had passed into definite forms by that mysterious power whose manifestations only we can comprehend.

[To be continued.]

XL.—*On the Invertebrate Marine Fauna and Fishes of St. Andrews.* By W. C. M'INTOSH.

[Continued from p. 274.]

Class CRUSTACEA.

Order PODOPHTHALMATA.

The stalk-eyed Crustacea of St. Andrews are chiefly northern in type; and though the species are not numerous, many are very plentifully represented. The most important forms here, as elsewhere, are the edible crab and the lobster. Both are caught in considerable numbers along the border of the rocks by means of the ordinary crab-pots, which are generally baited with fragments of grey gurnards and other fishes of little value. The most successful ground is off the East Rocks, though a very large lobster in the Museum of the University was procured to the north of the West Rocks. Some of the fishermen have an idea that if a lobster enters a trap first, none of the edible crabs will venture beside it, whereas a lobster will invade the crab-pot though a dozen of the former are already there. Constant attacks seem to have diminished the numbers of both species, and especially of the lobster. I have never seen any of the latter between tide-marks; but young edible crabs are common under ledges and stones, and even in the sand at low water, their presence in

the latter being recognized by a depression. The common shore-crab occurs everywhere along the rocky border, both between tide-marks and in the laminarian region. This ubiquitous species lurks in the retired apertures and clefts amongst and under the rocks, especially where these have a bottom of soft sand or dark mud. In this it buries itself so as to retain moisture in the gills, while the anterior part of the carapace is uncovered, probably for quiet observation. In these situations it quite understands an attempt to capture it; and there are few examples, if any, in which, by seizing the crooked iron with its chelæ, it has allowed itself to be drawn out. On the contrary, it endeavours to escape with much effort and considerable agility. Even when quite invisible its presence may be detected by striking the rock, when the grating of the carapace is heard as the animal retreats. It is often to be found in positions which seem any thing but comfortable—amongst blackened and putrefying animal remains, in muddy and odoriferous pools tenanted by none except itself. In these circumstances the body is coated with mud, which fills up the irregularities of its conformation, and loads the abdominal feet and hairs; yet the crab is vigorous and healthy, and out-lives sanitary apprehensions.

Under almost every stone within reach of the tide young specimens occur. At low water the full-grown crabs seek the hiding-places just mentioned, or shade themselves under the blades of the seaweeds in the rock-pools. Occasionally one is found adhering to the soft body of a moulting brother and, cannibal-like, devouring the branchiæ, new carapace, and other soft organs with savage pertinacity, while the old shell has not quite fallen from its victim. Moulting shore-crabs are generally found alone, as if aware of their helplessness, and dreading, with some degree of correctness, the voracity of enemies and even unscrupulous relations. Very slight injury kills them in this condition; and of course, for a time, they are incapable of defending themselves from even weak assailants.

The shore-crab is found in pools at the East Rocks where no other marine articulate of the same class occurs; and the water cannot but be brackish, since the pools are not filled by ordinary tides, and fresh streams from the crags flow in the neighbourhood. In these resorts the colour of the crab is not so pretty, being of a muddy green with pale limbs; and the specimens in the highest pools are generally small. It is not surprising, however, to find them in such places, after watching their activity in the innumerable brackish lakes of the Outer Hebrides, and their evident comfort in perambulating the muddy flats even where streams of fresh water abound.

On land, *Carcinus mænas* is, perhaps, the most active British crab, especially in regard to offence, defence, and escape. It scrambles over the rugged rocks with astonishing speed, while defending itself with its uplifted chelæ; and so fierce is it in attack, that having once seized an object with the latter the spasmodic effort is sometimes so great that the limb separates from the trunk at the base. The males frequently engage in combat; and a fatal issue would more frequently ensue, were it not for the provision whereby hæmorrhage is speedily arrested and the lost portion repaired or reproduced. Few specimens, indeed, are quite free from injury. Some have recently repaired wounds of the carapace, others have lost an eye, an antenna, or one or more limbs. They surpass most marine animals in their powers of enduring life at a distance from sea-water, and may easily be kept for several weeks in a botanic vasculum.

The shore-crab is strictly carnivorous and, as already mentioned, even relishes its fellows. It is a curious feature in its history that it suffers serious annoyance and injury from the young of the common mussel, which plant themselves in its orbits, in the sockets of the internal antennæ, in the branchial chambers, and under the tail—in the former case often destroying both eyes. It feeds with avidity on the mussel in its adult state; so that here is an instance of a helpless young form avenging the destruction of the mature. The shore-crab, again, is devoured by many fishes: thus in the stomach of a *Cottus bubalis* I have found five or six specimens, two entire and upwards of two inches across the carapace. The *Cottus*, however, unfortunately came in the way of a large frogfish, which found a place for it in its capacious stomach, though nine full-grown flounders were already present. In many parts of Britain and the continent the shore-crab is used as food by man (and this is a safe-enough practice so long as it is well boiled, internal parasites being abundant); but at St. Andrews it is only employed occasionally for bait.

Myriads of the young of this species in the zoëa-stage occur at the surface of the bay in autumn, and may easily be kept alive, so as to show the subsequent stages of development.

Besides those already mentioned, many of the other forms are very common, such as *Stenorhynchus rostratus*, *Inachus*, *Hyas*, *Portumnus variegatus*, the *Portuni*, *Pinnotheres*, *Ebalia*, and *Nephrops* in deep water, *Porcellana*, the *Paguri*, *Galathea*, and *Crangon* between tide-marks, and in both regions *Hippolyte*, *Pandalus*, and *Palaemon*. In deep water swarms of *Hyas coarctatus* for the most part take the place of *H. araneus*. As a littoral form *Palaemon squilla* is local, but in company with

Pandalus annulicornis it is abundant in deep water. The common shrimp is seldom captured by man for food. *Portunus variegatus* is often the only form visible on the West Sands, and is very plentiful. The rarer forms are *Eurynome*, *Pirimela*, *Lithodes*, *Gebia deltura*, *Hippolyte spinus*, and *Doryphorus Gordoni*.

In contrast with the fauna of St. Andrews, we have in the mild sea of the west of Scotland the fine velvet crabs (*Portunus puber*) amongst the seaweeds between tide-marks. The common lobster is also much more abundant, though the wholesale fishing has of late years told severely on this crustacean, even on the most remote shores of the Outer Hebrides—as, for instance, off the rocks of Haskeir near the north-west point of North Uist, where the frequent inroads of the fishermen with their lobster-pots and floats have rendered even the seals less frequent in their accustomed haunts. *Xantho*, *Munida*, and the rarer species of *Crangon* and *Hippolyte* are also absent from St. Andrews. In the south of Britain, again, are the splendid spiny lobsters off the rocky shores, velvet crabs, *Pirimela*, and *Ebalia* under stones between tide-marks, *Alpheus ruber* and *Pagurus cuanensis* in littoral pools, *Pilumnus* in the crevices of the tidal rocks, *Pagurus Prideauxii* with the beautiful *Adamsia* adherent to its protecting shell, *Maia**, *Dromia*, and *Polybius*. In the northern waters swarms of the hardy *Portunus pusillus*, *P. tuberculatus*, *Pagurus pubescens*, and *Pandalus brevirostris* are characteristic, besides the rarer *Pagurus tricarinatus*, *Crangon serratus*, and *Sabinæa septemcarinata*.

I am indebted to the Rev. A. M. Norman for kind assistance with several species of Palæmonidæ and Galatheidæ.

Suborder STOMAPODA.

Fam. Mysidæ.

Genus MYSID, Latreille.

Mysis flexuosa, O. F. Müller; Bell, Brit. Crust. p. 336
(as *M. chameleon*).

Very abundant in rock-pools.

Mysis vulgaris, J. V. Thompson; Bell, *op. cit.* p. 339.

Occasionally with the former in rock-pools; much less common.

* It was recently stated in 'Land and Water' that *Maia squinado* had been procured near the Bell Rock; but, by the kindness of Mr. F. Buckland, who forwarded the specimen, I am enabled to observe that it was only *Lithodes maia*.

Mysis Griffithsiae, Bell, *op. cit.* p. 342.

Not uncommon in rock-pools, and occasionally thrown on the West Sands in multitudes after storms.

Suborder DECAPODA.

Tribe *MACROURA*.

Fam. *Palæmonidæ*.

Genus *PALÆMON*, Fab.

Palæmon squilla, L. ; Bell, *op. cit.* p. 305.

Common in pools beyond the Rock and Spindle and in the stomachs of cod.

Genus *PANDALUS*, Leach.

Pandalus annulicornis, Leach ; Bell, *op. cit.* p. 297.

Abundant from the laminarian region to deep water, and also in the stomachs of cod and haddock.

Genus *HIPPOLYTE*, Leach.

Hippolyte varians, Leach ; Bell, *op. cit.* p. 286.

Frequent in rock-pools and ranging thence to deep water ; stomachs of haddock.

Hippolyte pusiola, Krøyer, Monogr. af Slægten Hippolytes Nordiske Arter, p. 319, pl. 3. f. 69-73 (*fide* Rev. A. M. Norman).

Occasionally from the coralline ground amongst shells and stones, and in pools at the East Rocks.

Hippolyte securifrons, Norman, Tyneside Nat. Field-Club Trans. vol. v. (1863), pl. 12. figs. 1-7.

Occasionally in the stomach of the flounder.

Hippolyte spinus, Sowerby ; Bell, *op. cit.* p. 284.

Occasionally in the stomach of the haddock.

Genus *DORYPHORUS*, Bate.

Doryphorus Gordoni, Bate, Nat. Hist. Review, vol. v. (1858), p. 51.

Under a large stone in a pool near low water at the East Rocks. Rare.

Fam. Crangonidæ.

Genus CRANGON, Fab.

Crangon vulgaris, Fab. ; Bell, *op. cit.* p. 256.

Abundant off the West Sands and in sandy tide-pools, as well as on the beach after storms.

Fam. Astacidæ.

Genus NEPHROPS, Leach.

Nephrops norvegicus, L. ; Bell, *op. cit.* p. 251.

Common in deep water and in the stomachs of cod.

Genus HOMARUS, M.-Edwards.

Homarus gammarus, L. ; Bell, *op. cit.* p. 242.

Common in the laminarian region.

Fam. Thalassinidæ.

Genus GEBIA, Leach.

Gebia deltura, Leach ; Bell, *op. cit.* p. 225.

Occasionally in the stomachs of cod and haddock.

Tribe ANOMURA.

Fam. Galatheidæ.

Genus GALATHEA, Fab.

Galathea strigosa, L. ; Bell, *op. cit.* p. 200.

Not uncommon in deep water and in the stomachs of cod and haddock.

Galathea squamifera, Mont. ; Bell, *op. cit.* p. 197.

Very common under stones near low water, especially in pools and runlets ; occasionally in the stomachs of cod.

Galathea dispersa, Bate, Proceed. Linn. Soc., Zool. vol. iii. p. 3.

Abundant in deep water, and in the stomachs of the cod, haddock, and flounder.

Fam. Paguridæ.

Genus PAGURUS, Fab.

Pagurus bernhardus, L. ; Bell, *op. cit.* p. 171.

Everywhere abundant between tide-marks and in deep water. A young specimen was lodged inside a fragment of a stalk of wheat.

This species has nine or ten branchiæ on each side, besides a rudimentary organ at the base of the first pair of foot-jaws. The latter have no branchial whips, and differ considerably from those of the *Brachyura*.

The first pair of foot-jaws have the inner division very much elongated, almost antenniform, and bordered with long hairs, while the external portion is small. In the next pair the inner division more closely agrees with the external in length, and the whole is not very different from the same part in *Carcinus mænas* minus the whip and branchia. The third pair is shorn of its whip and large flap, and has the middle segment * represented by a narrow pedicle. The fourth pair has a narrow shield turned over at the free edge, and, instead of the two narrow spikes below, there is a flattened organ which forks into a narrow and a broad flap at the tip. The fifth pair has its inner division broad and flattened, and its outer small, but widened at the tip; the median division has a very regular arrangement of bristles at its tip, which points or slopes inwards.

The parasitic *Peltogaster paguri* frequently occurs on the abdomen.

Pagurus cuanensis, Thompson ; Bell, *op. cit.* p. 178.

Occasionally from deep water.

Pagurus ulidianus, Thompson (?); Bell, *op. cit.* p. 180.

St. Andrews Museum. I cannot speak with certainty of this form.

Pagurus levis, Thompson ; Bell, *op. cit.* p. 184.

Occasionally in the stomach of the haddock.

Fam. Porcellanidæ.

Genus PORCELLANA, Lamarck.

Porcellana platycheles, Penn. ; Bell, *op. cit.* p. 190.

Abundant under stones between tide-marks, especially in

* Corresponding to *d*, fig. 3, Trans. Linn. Soc. vol. xxiv. p. 86.

runlets, and on muddy ground. A group of young forms of some size may sometimes be seen in company with their parents.

The first pair of foot-jaws have their two terminal segments furnished with the longest hairs (proportionally) yet met with in the local forms. The hairs have a double row of spikes, diminishing towards base and tip, and cease before arriving at the end of the hair, which has very fine linear serrations. The external division has a powerful triangular, and somewhat tapering, lower segment, and a delicate appendage fringed with a brush of spiked hairs at the tip. The second pair has the external division much flattened, lanceolate, and with hairs having spiked bases and serrated tips on the outer edge; the hairs also occur generally along the inner margin, and are frequently sheathed in mud and particles of all kinds. The third pair consists of three portions furnished with long branched hairs. The fourth pair has the large flat shield surrounded with branched hairs; next is a curved tapering portion with bristles having short spikes towards the tip; then come a series of flattened organs with truncate tips covered with spiked hairs. The fifth pair has three divisions—an inner irregular portion with hairs shortly branched on its free edge, a middle and somewhat club-shaped piece with rather stiff serrated hairs scantily spiked at the base, and a curiously curved and rather slender inner portion with about half a dozen finely serrated hairs on one side of its tip.

The hairs on the outer border of the chelæ are densely plumose; and hence it is exceedingly difficult to clean them from mud and sand for the cabinet.

Porcellana longicornis, L.; Bell, *op. cit.* p. 193.

As common as the former, in similar, though not muddy, situations. The embryos are found in the ova in August; and many young occur under stones in November and December.

Fam. Lithodidæ.

Genus LITHODES, Latr.

Lithodes maia, L.; Bell, *op. cit.* p. 165.

Not uncommon in deep water, whence it is brought by the fishing-boats.

Tribe *BRACHYURA*.Fam. *Leucosiadæ*.Genus *EBALIA*, Leach.

Ebalia tuberosa, Penn. ; Bell, *op. cit.* p. 141.

Not uncommon in the stomachs of cod, and occasionally from deep water.

Ebalia Cranchii, Leach ; Bell, *op. cit.* p. 148.

Occasionally in the stomach of the haddock.

Fam. *Maiidæ*.Genus *INACHUS*, Fab.

Inachus dorsettensis, Penn. ; Bell, *op. cit.* p. 13.

Not uncommon in the stomach of the cod.

Inachus dorkynchus, Leach ; Bell, *op. cit.* p. 16.

Occasionally under stones near low-water mark. In the stomach of one were fragments of *Ulva*, and in another the débris of a large sessile-eyed crustacean. The hairs on this species are shaped like the horn of the chamois ; and some have a slight enlargement at the base.

Genus *HYAS*, Leach.

Hyas araneus, L. ; Bell, *op. cit.* p. 31.

Abundant under ledges in rock-pools, cast ashore on the West Sands after storms, in the crab-pots, and in the stomach of the cod.

This species has eight branchial processes on each side—four lateral, two anterior, and one to each of the first two pairs of foot-jaws. Their structure resembles that described in *Carcinus mænas*. The ova apparently of a small leech (*Pontobdella*) are often found attached to the walls of the branchial chamber.

The number and variety of parasitic growths, both vegetable and animal, on the carapace of this form are remarkable. *Balani* of two species cover the back almost with a continuous rugose pile, adhering to the limbs, the abdomen, the foot-jaws, or each other. Coils of *Serpulæ* and hard sandy tubes of *Sabellaria* interlace with these and fill up the depressions, and with the former occur on the tip of the abdomen as well as on

less mobile situations. Fine tufts of *Sertularia pumila* and *Crisia eburnea* adorn the surface of the carapace in others or the parasitic algæ thereon; while *Halichondria panicea* forms a thick rugged crust, from which *Balani*, *Serpulæ*, *Anomia*, zoophytes, and seaweeds emerge. Even the sockets of the eyes are invaded by the sponge. Moreover young examples are not unfrequently clothed with thick tufts of *Obelia geniculata*. It would appear that it is not always on attaining full growth that moulting ceases for considerable intervals, since small specimens are found as completely covered with parasitic growths. In the rock-pools the carapace often forms a moving forest of seaweeds; and in such specimens the shell is frequently fragile, so that the extraneous covering may be of use for protection, or else had grown with unusual rapidity, even before the carapace became fully consolidated.

One old example had the internal antennæ quite fixed by a hard sand-tube of *Sabellaria*; and the young of the common mussel are occasionally found in the cavities for the eyes.

In the young females the genital apertures are small, and the abdomen less developed; while in the adult the latter becomes hypertrophied, hollowed out on its ventral surface by the bending downwards of the outer edges, and touches the bases of the legs on each side.

Hyas coarctatus, Leach; Bell, *op. cit.* p. 35.

Common in deep water, and procured in hundreds amongst the coralline débris in the fishing-boats; frequent in the stomachs of cod, haddock, and flounders.

Fam. Leptopodiadæ.

Genus STENORHYNCHUS, Lam.

Stenorhynchus rostratus, L.; Bell, *op. cit.* p. 2
(as *S. phalangium*).

Abundant in the coralline region, in the stomachs of cod and haddock, and occasionally under stones at low water. Fragments of sessile-eyed Crustacea and sand occurred in the stomachs of those examined. Males greatly preponderate.

Fam. Parthenopidæ.

Genus EURYNOME, Leach.

Eurynome aspera, Penn.; Bell, *op. cit.* p. 46.

A few specimens were procured from the coralline ground. Rare.

Fam. Canceridæ.

Genus CANCER, L.

Cancer pagurus, L. ; Bell, *op. cit.* p. 59.

Abundant all round the rocky border in the laminarian region, and frequent between tide-marks. In the stomach of this species are many curious parasites, such as *Tetrarhynchus* and *Echinorhynchus*, probably derived from its food. Sections of the carapace show internally tubular processes, apparently connected with the hairs.

Genus PRIMELA, Leach.

Primela denticulata, Mont. ; Bell, *op. cit.* p. 72.

Occasionally from deep water. Rare.

Fam. Portunidæ.

Genus PORTUNUS, Leach.

Portunus depurator, L. ; Bell, *op. cit.* p. 101.

Dredged occasionally off the West Rocks on a sandy bottom, cast ashore by storms, or found in the stomach of the cod.

Portunus marmoreus, Leach ; Bell, *op. cit.* p. 105.

On the West Sands after storms. Rather rare.

Portunus holsatus, Fab. ; Bell, *op. cit.* p. 109.

Not uncommon in the stomachs of cod and haddock. *Sacculina* occurs on this species occasionally.

Portunus pusillus, Leach ; Bell, *op. cit.* p. 112.

Occasionally from deep water, and rather common in the stomachs of the haddock and flounder.

Genus PORTUMNUS, Leach.

Portumnus variegatus, Leach ; Bell, *op. cit.* p. 85.

Abundant on the sandy ground off the West Sands.

Genus CARCINUS, Leach.

Carcinus maenas, L. ; Bell, *op. cit.* p. 76.

Everywhere abundant between tide-marks and in the

laminarian region. Occasionally used as bait. Swarms in the zoëa-stage occur in autumn at the surface of the water in the bay; they are almost invisible with the exception of the greenish-blue eyes.

This crustacean has nine branchiæ:—the first rudimentary, and attached to the horizontal portion of the first pair of foot-jaws; the succeeding, rather long and delicate organs, fixed to the second pair of foot-jaws on opposite sides of the horizontal portion; while six are attached to the body of the animal, four being prominent, as in allied forms. The flabellum of the first pair passes between the four prominent and larger branchiæ and the apodematus region, so as to sweep their inner surface; while the same organ of the second pair goes between the same portion of the shell and the fifth and sixth branchiæ (counting from behind), and may also affect the exposed surface of the seventh, which lies in the groove anteriorly. The long and finely curved flabellum of the third pair of foot-jaws curves externally, so as to brush all the seven. The great development of this organ, its central calcareous bow, and long hairs are thus explained. The branchial laminae are arranged with their edges to the afferent current, which crosses the organs at right angles to their long axes, and so impinges between the plates. The action of the broad shield of the fourth pair of foot-jaws, again, affects the ingoing stream, and plays upon the large flat surface at the base of the flabellum of the third pair. It would tend thus to spread out the long hairs of the latter, and direct the current upwards over the branchial laminae. The fifth pair as a whole would seem to be connected with the buccal rather than the respiratory apparatus; for the curiously twisted portion (*c*, fig. 6, Trans. Linn. Soc. vol. xxiv. p. 88) is nicely adapted to the deep anterior notch of the mandible, while the curved portion (*a*) enters the mouth above the chitinous tissue filling up the posterior notch of the mandible. The tuft of long hairs (*e*, *loc. cit.*), however, may render some assistance to the branchial portion of the fourth pair of foot-jaws in contact with it.

The appendage of the mandible (*a*, fig. 7, *op. cit.*) seems to have a considerable influence in the prehension and direction of the food between the maxillæ; it has lateral motion as well as flexion and extension. The flexible process filling up the gap in the underpart of the maxilla, and connected with the lip beneath the latter, would seem to prevent the escape of particles in biting and deglutition. It is attached to a firm horny basis, which has free horizontal, but little or no vertical motion, except when greatly extended.

In females bearing eggs the muscles on the external or

under surface of the intestinal tract greatly increase in size at the junction of the abdomen with the cephalothorax. In males and females without ova the exterior of the gut is sparingly supplied with such tissue.

This crab affords a good example of the "commensalisme" of Prof. van Beneden. *Nemertes carcinophila* abounds on the hairs bearing ova; and the young of the common mussel and other adventitious growths are common, besides *Sacculina*; Trematode larvæ in the liver and other parts. Various abnormalities from injury also occur. The colours of the males are often remarkably bright, both on the upper and under surfaces of the carapace.

Fam. Corystidæ.

Genus ATELECYCLUS, Leach.

Atelecyclus septemdentatus, Mont.; Bell, *op. cit.* p. 153.

Frequent in the stomachs of cod.

Genus CORYSTES, Latreille.

Corystes cassivelaunus, Penn.; Bell, *op. cit.* p. 159.

Common on the West Sands after severe storms.

Fam. Pinnotheridæ.

Genus PINNOTHERES, Latreille.

Pinnotheres pisum, L.; Bell, *op. cit.* p. 121.

Frequent in *Mytilus modiolus*.

[To be continued.]

XLI.—Description of a remarkable kind of Air-bladder.

By Dr. ALBERT GÜNTHER, F.R.S.

[Plate XVIII.]

AMONG the specimens of mollusks purchased by the Trustees of the British Museum from the Collection of the late Dr. van Lidth de Jeude there was a preparation, which, on closer inspection, proved to be the air-bladder of a fish. Although there was no indication as regards its origin, I have no doubt that the species from which it had been taken belonged to the Sciaenidæ, a family distinguished by the singular structure of that organ. In some degree the present specimen resembles